thereby. Now in elementary geometry it is proved that angles at the center are proportional to the intercepted arcs.

Let $s[L]$, $r[L]$, and θ be the arc, radius, and center angle, s and r being measured in the same *length-unit*, the angle unit being at present undetermined. Then $s[L]=kr[L]\theta$. Let us now *assume* $\theta=1$, *the unit angle, when* $s=r$. Hence, $k=1$, under this assumption. We thus have as our unit angle, $[\Theta]$, the angle at the center of a circle, which intercepts an arc equal in length to the radius of the circle. Hence, we have the general relation $s[L]=r[L]\,\theta\,[\Theta]$ and $\theta[\Theta]=s/r$. This unit angle, $[\Theta]$, is called a *radian*. In terms of the fundamental units of length, mass, and time, it is of zero dimensions, since $[\Theta]=\dfrac{s[L]}{r[L]}[M^\circ][T^\circ]=L^\circ M^\circ T^\circ$, s being equal to r. From this we see that the great advantage of this unit of angular measure over that of any other is that it avoids, as remarked by Mr. Schmall, the introduction of a *coefficient of variation* different from unity.

PROBLEMS FOR SOLUTION.

ALGEBRA.

329. Proposed by C. N. SCHMALL, 604 East 5th Street, New York City.

Between the quantities a and b there are inserted n arithmetical and n harmonical means, and a series of n terms is formed by dividing each arithmetical by the corresponding harmonical mean. Show that the sum of the series is, $n\left[1+\dfrac{n+2}{n+1}\cdot\dfrac{(a-b)^2}{6ab}\right]$.

330. Proposed by R. D. CARMICHAEL, Princeton, N. J.

An important function in the Theory of Numbers is one defined thus: $f(x)=1$ when $x>0$, $f(x)=0$ when $x=0$, $f(x)=-1$ when $x<0$. Two analytic expressions for $f(x)$ are the following:

$$f(x)=\lim_{n\doteq\infty} x^{1/(2n-1)},\ n=1,\,2,\,\ldots;\quad f(x)=\lim_{n\doteq\infty}\frac{(x+1)^n-(x+1)^{-n}}{(x+1)^n+(x+1)^{-n}},\ x>-1.$$

It is required to find other non-trigonometric analytic expressions for this function. (There are several representations of $f(x)$ by means of trigonometric functions.)

GEOMETRY.

357. Proposed by E. R. HOYT, St. Louis, Mo.

A room is 30 feet long, 12 feet wide, and 12 feet high. At one end of the room, 3 feet from the floor, and midway from the sides, is a spider. At the other end, 9 feet from the floor, and midway from the sides, is a fly. Determine the shortest path by way of the floor, ends, sides, and ceiling, the spider can take to capture the fly.